

What is claimed is:

1 1. An analyte sensing device for sensing a concentration of analyte in a fluid,
2 the analyte sensing device comprising:
3 a housing; and
4 an analyte sensing component disposed within the housing and including a first
5 radiation converting component that is capable of converting radiation of a first
6 wavelength to at least one different wavelength, wherein the efficiency of conversion is
7 dependent on the concentration of the analyte within the housing.

1 2. The analyte sensing device of claim 1 wherein the housing includes a
2 permeable or semi-permeable membrane.

1 3. The analyte sensing device of claim 2 wherein the membrane is
2 comprised of a cellulose acetate material.

1 4. The analyte sensing device of claim 1 wherein the housing includes at
2 least a permeable or semi-permeable portion.

1 5. The analyte sensing device of claim 4 wherein the permeable or semi-
2 permeable portion of the housing is comprised of a cellulose acetate material.

1 6. The analyte sensing device of claim 4 wherein the housing includes a
2 hollow dialysis fiber.

1 7. The analyte sensing device of claim 1 wherein analyte sensing component
2 further includes an analyte-specific binding ligand.

1 8. The analyte sensing device of claim 7 wherein the analyte sensing
2 component further includes a macroporous matrix wherein the analyte-specific binding
3 ligand is attached to the surface of the macroporous matrix or embedded within the
4 macroporous matrix.

1 9. The analyte sensing device of claim 8 wherein the analyte is glucose and
2 wherein the macroporous matrix includes agarose beads and the analyte-specific
3 binding ligand includes a lectin.

1 10. The analyte sensing device of claim 9 wherein the lectin is Concanavalin
2 A.

1 11. The analyte sensing device of claim 7 wherein the analyte-specific binding
2 ligand is covalently labeled with or is in close proximity to a radiation absorbing
3 component.

1 12. The analyte sensing device of claim 1 wherein the analyte sensing
2 component further comprises an analyte-analogue capable of being bound by analyte-
3 specific analyte binding ligand.

1 13. The analyte sensing device of claim 1 wherein the analyte sensing
2 component further includes a second radiation converting component that is capable of
3 converting radiation of a second wavelength to at least one different wavelength
4 wherein the efficiency of conversion is dependent on the concentration of the analyte
5 within the housing.

1 14. The analyte sensing device of claim 1 wherein the analyte sensing
2 component further includes a second radiation converting chromophore that is capable
3 of converting radiation of a second wavelength to at least one different wavelength
4 wherein the efficiency of conversion is independent or substantially independent of the
5 concentration of the analyte within the housing.

1 15. The analyte sensing device of claim 1 wherein the device is capable of
2 being implanted within subcutaneous tissue of an animal body.

1 16. The analyte sensing device of claim 1 wherein the analyte sensing
2 component further comprises:
3 an analyte-analogue;
4 a macroporous matrix material;
5 an analyte-specific binding ligand attached to the surface of or throughout the
6 macroporous matrix material and capable of binding analyte and/or analyte-analogue;
7 a radiation absorbing component in close proximity to the analyte-specific binding
8 ligand; and

9 wherein the first radiation converting component is attached to the analyte-
10 analogue.

1 17. The analyte sensing device of claim 16 wherein the housing comprises a
2 permeable or semi-permeable membrane which allows analyte to move into or out of
3 the housing but does not allow analyte sensing component to move out of the housing.

1 18. The analyte sensing device of claim 16 wherein the efficiency of
2 conversion of radiation at the first wavelength to radiation by the first radiation
3 converting component is decreased when the analyte-analogue is bound by the analyte-
4 specific binding ligand.

1 19. The analyte sensing device of claim 16 wherein the analyte-analogue is a
2 dextran.

1 20. The analyte sensing device of claim 16 wherein the analyte-analogue is a
2 glycosylated or mannosylated protein.

1 21. The analyte sensing device of claim 16 wherein the analyte-analogue is a
2 glycosylated or mannosylated dendrimer.

1 22. The analyte sensing device of claim 16 wherein the first radiation
2 converting component is Alexa647.

1 23. The analyte sensing device of claim 16 wherein the analyte-specific
2 binding ligand is a lectin

1 24. The analyte sensing device of claim 23 wherein the lectin is Concanavalin
2 A.

1 25. The analyte sensing device of claim 23 wherein the lectin is *Lens culinaris*
2 lectin.

1 26. The analyte sensing device of claim 16 wherein the radiation absorbing
2 component is QSY21.

1 27. The analyte sensing device of claim 16 wherein the radiation absorbing
2 component is covalently bound to the analyte-specific binding ligand.

1 28. The analyte sensing device of claim 16 wherein the radiation absorbing
2 component is attached to the surface of or embedded throughout the macroporous
3 matrix.

1 29. The analyte sensing device of claim 16 further including a second
2 radiation converting component capable of converting radiation of a second wavelength
3 into radiation of at least a wavelength that is different from the second wavelength.

1 30. The analyte sensing device of claim 29 wherein the second radiation
2 converting component is LD800.

1 31. The analyte sensing device of claim 16 wherein the analyte is glucose.

1 32. The analyte sensing device of claim 1 wherein the analyte sensing
2 component further comprises:

3 a macroporous matrix material;
4 an analyte-analogue attached to the macroporous matrix;
5 a radiation absorbing component attached to the macroporous matrix material;
6 an analyte-specific binding ligand; and
7 wherein the first radiation converting component is attached to the analyte-
8 specific binding ligand.

1 33. The analyte sensing device of claim 32 wherein the housing comprises a
2 permeable or semi-permeable membrane which allows analyte to move into or out of
3 the housing but does not allow analyte sensing component to move out of the housing.

1 34. The analyte sensing device of claim 32 wherein the efficiency of
2 conversion of radiation at the first wavelength to radiation by the first radiation
3 converting component is decreased when the analyte-specific binding ligand is bound to
4 the analyte-analogue.

1 35. The analyte sensing device of claim 32 wherein the macroporous matrix is
2 a cross-linked dextran polymer and includes the analyte-analogue.

1 36. The analyte sensing device of claim 32 wherein the radiation absorbing
2 component is QSY21.

1 37. The analyte sensing device of claim 32 wherein the analyte-specific
2 binding ligand is a lectin.

1 38. The analyte sensing device of claim 37 wherein the lectin is Concanavalin
2 A.

1 39. The analyte sensing device of claim 37 wherein the lectin is *Lens culinaris*
2 lectin.

1 40. The analyte sensing device of claim 32 wherein the first radiation
2 converting component is Alexa647.

1 41. The analyte sensing device of claim 32 further including a second
2 radiation converting component capable of converting radiation of a second wavelength
3 into radiation having a wavelength that is different from the second wavelength.

1 42. The analyte sensing device of claim 41 wherein the second radiation
2 converting component is LD800.

1 43. The analyte sensing device of claim 32 wherein the analyte is glucose.

1 44. The analyte sensing device of claim 1 wherein the analyte sensing
2 component further comprises:

3 an analyte-analogue;

4 a radiation absorbing component attached to the analyte-analogue;

5 a macroporous matrix material;

6 an analyte-specific binding ligand attached to the surface of or throughout the
7 macroporous matrix material and capable of binding analyte and/or analyte-analogue;

8 and

9 wherein the first radiation converting component is covalently bound to or is in
10 close proximity to the analyte-specific binding ligand.

1 45. The analyte sensing device of claim 44 wherein the housing comprises a
2 permeable or semi-permeable membrane which allows analyte to move into or out of
3 the housing but does not allow analyte sensing component to move out of the housing.

1 46. The analyte sensing device of claim 44 wherein the efficiency of
2 conversion of radiation at the first wavelength to radiation by the first radiation

3 converting component is decreased when the analyte-analogue is bound by the analyte-
4 specific binding ligand.

1 47. The analyte sensing device of claim 44 wherein the analyte-analogue is a
2 dextran.

1 48. The analyte sensing device of claim 44 wherein the analyte-analogue is a
2 glycosylated or mannosylated protein.

1 49. The analyte sensing device of claim 44 wherein the analyte-analogue is a
2 glycosylated or mannosylated dendrimer.

1 50. The analyte sensing device of claim 44 wherein the first radiation
2 converting component is Alexa647.

1 51. The analyte sensing device of claim 44 wherein the analyte-specific
2 binding ligand is a lectin.

1 52. The analyte sensing device of claim 51 wherein the lectin is Concanavalin
2 A.

1 53. The analyte sensing device of claim 51 wherein the lectin is *Lens culinaris*
2 lectin

1 54. The analyte sensing device of claim 44 wherein the radiation absorbing
2 component is QSY21.

1 55. The analyte sensing device of claim 43 wherein the radiation absorbing
2 component is attached to the analyte-analogue.

1 56. The analyte sensing device of claim 44 further including a second
2 radiation converting component capable of converting radiation of a second wavelength
3 into radiation having a wavelength that is different from the second wavelength.

1 57. The analyte sensing device of claim 56 wherein the second radiation
2 converting component is LD800.

1 58. The analyte sensing device of claim 44 wherein the analyte is glucose.

1 59. The analyte sensing device of claim 1 wherein the analyte sensing
2 component further comprising:
3 a macroporous matrix material;
4 an analyte-analogue attached to the macroporous matrix material;
5 an analyte-specific binding ligand;
6 a radiation absorbing component attached to the analyte-specific binding ligand;
7 and

8 wherein the first radiation converting component is attached to the macroporous
9 matrix material.

1 60. The analyte sensing device of claim 59 wherein the housing comprises a
2 permeable or semi-permeable membrane which allows analyte to move into or out of
3 the housing but does not allow analyte sensing component to move out of the housing.

1 61. The analyte sensing device of claim 59 wherein the efficiency of
2 conversion of radiation at the first wavelength to radiation by the first radiation
3 converting component is decreased when the analyte-specific binding ligand is bound to
4 the analyte-analogue.

1 62. The analyte sensing device of claim 59 wherein the macroporous matrix is
2 a cross-linked dextran polymer and includes the analyte-analogue.

1 63. The analyte sensing device of claim 59 wherein the radiation absorbing
2 component is QSY21.

1 64. The analyte sensing device of claim 59 wherein the analyte-specific
2 binding ligand is a lectin.

1 65. The analyte sensing device of claim 64 wherein the lectin is Concanavalin
2 A.

1 66. The analyte sensing device of claim 64 wherein the lectin is *Lens culinaris*
2 lectin.

1 67. The analyte sensing device of claim 59 wherein the first radiation
2 converting component is Alexa647.

1 68. The analyte sensing device of claim 59 further including a second
2 radiation converting component capable of converting radiation of a second wavelength
3 into radiation having a wavelength that is different from the second wavelength.

1 69. The analyte sensing device of claim 68 wherein the second radiation
2 converting component is LD800.

1 70. The analyte sensing device of claim 59 wherein the analyte is glucose.

1 71. An analyte sensing system for sensing a concentration of analyte in a
2 fluid, the analyte sensing system comprising:
3 an analyte sensing device including:
4 a housing; and
5 an analyte sensing component disposed within the housing and including
6 a first radiation converting component that is capable of converting radiation of a
7 first wavelength to at least one different wavelength wherein the efficiency of
8 conversion is dependent on the concentration of the analyte within the housing;

9 a radiation providing unit to provide radiation at the first wavelength; and
10 a radiation detecting unit to detect the radiation of at least one different
11 wavelength and output data which is representative of the intensity of the radiation of
12 the at least one different wavelength.

1 72. The analyte sensing system of claim 71 further including an analysis unit,
2 coupled to the radiation detecting unit, to determine the concentration of analyte within
3 the housing using the data which is representative of the intensity of the radiation of the
4 at least one different wavelength

1 73. The analyte sensing system of claim 71 wherein the radiation detecting
2 unit includes a plurality of radiation detecting devices wherein each device is capable of
3 detecting a wavelength-specific portion of radiation.

1 74. The analyte sensing system of claim 71 wherein:
2 the first radiation converting component is capable of converting radiation of the
3 first wavelength to radiation having a plurality of wavelengths wherein the efficiency of
4 conversion is dependent on the concentration of the analyte within the housing; and
5 the radiation detecting unit includes a plurality of radiation detecting devices
6 wherein each device is capable of detecting at least one of the plurality of wavelengths.

1 75. The analyte sensing system of claim 71 wherein:

2 the first radiation converting component is capable of converting radiation of the
3 first wavelength to radiation having a plurality of wavelengths within a first wavelength
4 range wherein the efficiency of conversion is dependent on the concentration of the
5 analyte inside within the housing; and

6 the radiation detecting unit includes a plurality of radiation detecting devices
7 wherein each device is capable of detecting radiation within the first wavelength range.

1 76. The analyte sensing system of claim 75 wherein the radiation detecting
2 unit includes one or more photodiode detectors or a CCD array.

1 77. The analyte sensing system of claim 71 wherein the radiation providing
2 unit is disposed within or adjacent to the housing.

1 78. The analyte sensing system of claim 71 wherein:
2 the analyte sensing component further includes a second radiation converting
3 component that is capable of converting radiation of a second wavelength to at least
4 one different wavelength wherein the efficiency of conversion is dependent on the
5 concentration of the analyte in the housing;

6 the radiation detecting unit outputs data which is representative of the intensity of
7 the radiation of the at least one different wavelength of the first and second radiation
8 converting chromophores; and

9 wherein the analyte sensing system further includes an analysis unit, coupled to
10 the radiation detecting unit, to determine the concentration of analyte in the housing
11 using the data output by the radiation detecting unit.

1 79. The analyte sensing system of claim 71 wherein:

2 the analyte sensing component further includes a second radiation converting
3 component that is capable of converting radiation of a second wavelength to at least
4 one different wavelength wherein the efficiency of conversion is independent or
5 substantially independent of the concentration of the analyte in the housing;

6 the radiation detecting unit outputs data which is representative of the intensity of
7 the radiation of the at least one different wavelength of the first and second radiation
8 converting chromophores; and

9 wherein the analyte sensing system further includes an analysis unit, coupled to
10 the radiation detecting unit, to determine the concentration of analyte inside the housing
11 using the data output by the radiation detecting unit.

1 80. The analyte sensing system of claim 79 wherein analysis unit uses a
2 difference in the intensities of radiation detected by the radiation detecting unit due to
3 the at least one different wavelength of the first radiation converting chromophore
4 relative to the at least one different wavelength of the second radiation converting
5 chromophore.

1 81. An analyte sensing device for sensing a concentration of analyte in a fluid,
2 the analyte sensing device comprising:
3 a polymeric matrix; and
4 an analyte sensing component disposed within the matrix and including a first
5 radiation converting component that is capable of converting radiation of a first
6 wavelength to at least one different wavelength wherein the efficiency of conversion is
7 dependent on the concentration of the analyte in the housing.

1 82. The analyte sensing device of claim 81 further including a housing that
2 surrounds polymeric matrix.

1 83. The analyte sensing device of claim 82 wherein the housing includes a
2 permeable or semi-permeable portion.

1 84. The analyte sensing device of claim 83 wherein the housing is comprised
2 of PEG and/or derivatives thereof, calcium phosphate, polyurethane, alginate,
3 regenerated cellulose acetate, chitosan, or combinations thereof.

1 85. The analyte sensing device of claim 82 further including covalent linkages
2 connected between the analyte sensing component and the housing.

1 86. The analyte sensing device of claim 82 further including covalent linkages
2 wherein the covalent linkages retain the analyte sensing component within the housing.

1 87. The analyte sensing device of claim 81 wherein the analyte sensing
2 component is embedded throughout the polymeric matrix.

1 88. The analyte sensing device of claim 81 wherein the polymeric matrix
2 surrounds the analyte sensing component.

1 89. The analyte sensing device of claim 81 further including a permeable or
2 semi-permeable capsule, disposed in polymeric matrix, wherein the analyte sensing
3 component is disposed in the capsule.

1 90. The analyte sensing device of claim 81 wherein analyte sensing
2 component further includes an analyte-specific binding ligand.

1 91. The analyte sensing device of claim 90 wherein the analyte sensing
2 component further includes a macroporous matrix layer wherein the analyte-specific
3 binding ligand is bound to the surface of the macroporous matrix layer or embedded
4 within the macroporous matrix layer.

1 92. The analyte sensing device of claim 90 wherein the analyte is glucose and
2 wherein the first radiation converting chromophore includes agarose beads and the
3 analyte-specific binding ligand includes a lectin.

1 93. The analyte sensing device of claim 90 wherein the lectin is Concanavalin
2 A.

1 94. The analyte sensing device of claim 90 wherein the analyte-specific
2 binding ligand is covalently labeled with or is in close proximity to the first radiation
3 converting chromophore.

1 95. The analyte sensing device of claim 81 wherein the analyte sensing
2 component further includes a second radiation converting chromophore that is capable
3 of converting radiation of a second wavelength to at least one different wavelength
4 wherein the efficiency of conversion is dependent on the concentration of the analyte in
5 the housing.

1 96. The analyte sensing device of claim 81 wherein the analyte sensing
2 component further includes a second radiation converting chromophore that is capable
3 of converting radiation of a second wavelength to at least one different wavelength
4 wherein the efficiency of conversion is independent or substantially independent of the
5 concentration of the analyte in the housing.

1 97. The analyte sensing device of claim 81 wherein the device is capable of
2 being implanted within subcutaneous tissue of an animal body.

1 98. A method for detecting the concentration of an analyte in a fluid, the
2 method comprising:

3 placing an analyte sensing device in communication with the fluid, the analyte
4 sensing device comprising:

5 a housing; and

6 an analyte sensing component disposed within the housing and including a first
7 radiation converting component that is capable of converting radiation of a first
8 wavelength to at least one different wavelength and wherein the efficiency of conversion
9 is dependent on the concentration of the analyte inside the housing;

10 providing radiation of a first wavelength to the analyte sensing device;

11 detecting radiation which has been modified or converted by the radiation
12 converting component of the analyte sensing component within the analyte sensing
13 device;

14 determining the efficiency of conversion of the provided radiation by the radiation
15 converting component; and

16 determining the concentration of the analyte based on the determined efficiency
17 of conversion.

1 99. The method of claim 98 wherein the fluid is the interstitial fluid or blood of
2 an animal and placing an analyte sensing device in communication with the fluid
3 includes implanting the analyte sensing device into the cutaneous or subdermal tissue
4 of the animal.

1 100. The method of claim 98 wherein the analyte sensing component further
2 includes a second radiation converting component capable of converting radiation of a
3 second wavelength into radiation of at least one different second wavelength.

1 101. The method of claim 98 wherein the analyte is glucose.